BEDROCK, SURFICIAL AND ENVIRONMENTAL GEOLOGY
TOWN OF ST. ANDREWS, N. B.

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INTRODUCTION

This report and accompanying bedrock and surficial geologic maps (Figs. 1 and 2) were prepared at the request of the Community Planning Branch, New Brunswick Department of Municipal Affairs, Fredericton, N.B.

The bedrock geology (Fig. 1) was compiled from the unpublished M.Sc. thesis of W. H. McIlwaine (1962), Ruitenberg (1968) and observations made for this report. The surficial geology was modified after maps by Hunter and Associates (1983) and Gadd (1973).

BEDROCK GEOLOGY

The St. Andrews Peninsula is underlain by gently dipping, greyish red sandstone, conglomerate and siltstone, with minor intercalated basalt flows of the Upper Devonian Perry Formation. Dawson (1861, 1862, 1863) described ten, and Smith and White (1905) identified thirty species of fossil plants in the Perry Formation, which established a Late Devonian age.

The most voluminous rock types in Unit 1 (Fig. 1) of the Perry Formation in the St. Andrews Peninsula are greyish red sandstone and pebbly sandstone. Quartz is the most abundant component, whereas feldspar, altered iron magnesian minerals and rock fragments are less common. Ferric

oxide and calcite occur as cementing materials.

The conglomerate in Unit 1 has a greater pebble density than the pebbly sandstone. The size of the pebbles varies from about .5 to 15 mm. The matrix is medium- to coarse-grained sand. Calcite is abundant near the base of the unit.

The siltstone in Unit 1 is light greyish red to greyish red and varies from massive to laminated. The massive variety is usually crumbly and blocky. Green spots are common where ferric oxides have been reduced around plant remains.

Basalt flows (Unit 2) are exposed on the west and east side of the St. Andrews Peninsula and on Ministers Island. The flows are conformable with the sedimentary rocks of Unit 1 and they vary from massive to amygdaloidal particularly near the top of the unit. The vesicles are generally filled with calcite or chlorite.

SURFICIAL GEOLOGY

The bedrock of the St. Andrews Peninsula has been intensely glaciated. Gadd (1971) recognized southeastern and southern directions of glaciation in the region.

Most of the bedrock in the peninsula is covered by a thin, generally less than 1 m thick, morainic veneer (Fig. 2, Unit A) or glacial till about 1 m or more thick (Unit B). The till is composed of a heterogeneous mixture of gravel,

sand, and boulders. A drumlin (Unit Ba) crosses the northeastern part of the town boundary.

Marine basin deposits (Unit C), composed of clay, silty clay, gravelly sand, and sandy gravel are exposed in most of the coastal area in the southern part of the peninsula. The thickness of these deposits varies from a thin veneer on bedrock to those 1 m or more thick.

ENVIRONMENTAL GEOLOGY

Three environmental problems have been of concern in St. Andrews: a) severe wave erosion of coastal rocks, b) quality of drinking water obtained from Chamcook Lake and c) pollution of nearby clam flats by effluents from the town.

Wave Erosion: The gently dipping red beds of the Perry Formation have relatively low resistance against wave erosion. In the intertidal zone, wave erosion has cut extensive platforms more or less concordant with bedding surfaces. Local residents in the harbour area report rates of erosion averaging as much as 15 cm per year. The ferric oxide and calcite cement are readily removed from these rocks thus causing them to crumble. The siltstone beds appear to be most severely affected, whereas the conglomerate and sandstone are relatively more resistant. The relative abundance of basalt flows has made Joes Point more resistant to wave erosion than other parts of the coast

underlain by red beds only. Sea level also is rising in the area (D. J. Scarratt, written communication 1983) and this further intensifies coastal erosion. Granite armor stone and cribbing have been used to reduce the effects of wave erosion where the waterfront is severely exposed to storms. It is notable that harbour dredging that is being planned (D. J. Scarratt, written communication) may result in soft sediment slumping and exposure of the cliff foot, thus further accelerating wave erosion.

Water Quality: The town derives its water supply from nearby Chamcook Lake, which constitutes part of a watershed that includes also Little Chamcook Lake, Limburner Lake and Welch Lake. Tests by the New Brunswick Department of Health have shown from time-to-time that, in certain parts of the town, water was unsafe because of bacterial contamination. Two possible causes for this contamination have been considered (Wilder 1976): a) contamination by effluents discharged from cottages around Chamcook Lake and other areas in the watershed, b) inadequate chlorination in the town distribution system. Coliform count determinations done on water samples from the lake between 1967 and 1976 indicate little evidence of serious pollution. However, no comprehensive bacteriological surveys were done at that time to determine the abundance of faecal coliform bacteria seasonally, horizontally and vertically in relation to the distribution of cottages and their facilities for waste disposal (Wilder, *ibid*). Such a survey was done by a Young

Canada Works team (D. J. Scarratt, written communication). High coliform counts were found in surface waters near concentrations of cottages. Coliform counts diminished with depth. High counts were also noted in areas where gulls roosted and in all nearshore areas following a heavy rainstorm. In addition to effluent emissions, the effects of exhaust fumes from increasing numbers of motorboats on water quality remain to be determined. Wilder (*ibid*) suggested that inadequate chlorination in parts of the town water distribution system also has contributed to high coliform bacteria counts. Inadequate flushing of the system permits particulate matter to adhere to the pipes where it acts as a medium for growth of bacteria.

In response to these investigations, the town rebuilt the fresh water inlet and lowered it from about six feet below surface to sixteen feet. A new reservoir was also built and new delivery lines were installed. A number of dead-end water lines were eliminated by installing cross links or by adopting a policy of permitting a slow discharge from the end of an otherwise dead-end line. All these measures allow for a lower level of chlorination than before.

Pollution of Clam Flats: Pollution of clam flats near St. Andrews Peninsula, resulting from effluents discharged by the town, appears to have been significantly reduced by the construction of a two-celled lagoon near Pagan Point in 1981. The first of these lagoons is mechanically aerated, whereas the second is a shallow polishing pond. The

effluents discharged by the lagoon are not treated at this time.

The lagoons were excavated in the relatively impermeable marine basin deposits. The plant was designed for a population of about 3500 people, but its capacity can be readily enlarged by increased aeration (Godfrey Associates Ltd., oral communication 1983). The treatment plant appears to be in good working order. The collection system on the other hand is subject to severe infiltration by heavy rain. As a result, raw sewage may enter St. Andrews Harbour or Passamaquoddy Bay directly via lift stations if the power fails or the station's pumping capacity is exceeded (Richards *et al.*, 1982).

Faecal coliform density tests have shown that the water quality of St. Andrews Harbour has improved significantly since the installation of the sewage treatment lagoon at Pagan Point (Richards *et al.*, 1982). Sampling around Navy Island showed faecal coliform levels sufficiently low to satisfy NSSP bacteriological requirements for approved shellfish growing areas. In the peninsula coastline from Joes Point to Katys Cove the water quality was still not up to NSSP standards.

CONCLUSIONS AND RECOMMENDATIONS

1. Rocks of the Perry Formation generally are subject to severe wave erosion, because the cementing materials,

calcite and hematite, are readily removed by weathering. Joes Point is more resistant to wave erosion than adjacent parts of the coast, because of the relative abundance of basalt flows at the point. Wave erosion should be periodically monitored in the St. Andrews Peninsula. This can be most easily accomplished by comparing low level air photos taken at intervals of about five years combined with regular ground checks. The most vulnerable areas can be readily identified in this way. Erosion rates in the highly vulnerable areas can be reduced with armor stone or cribbing as is the regular practice now.

2. The town has significantly reduced the faecal coliform levels in its water supply by lowering the water inlet at Chamcook Lake and by rebuilding the water distribution system. Periodic monitoring of faecal coliform levels near the water intake area will be necessary, however, to assure that the water quality is maintained. When bacteria levels exceed acceptable levels, measures should be taken to prevent new cottages from being built in the watershed. In addition, effluent discharge from existing cottages should be strictly controlled. Monitoring of water quality and regular flushing of the town's water distribution system, as is being done now, should be continued to maintain water quality.

3. Pollution of clam flats by pollutants discharged from the town have been significantly reduced with the installation of a two celled sewage treatment lagoon at Pagans Point. Raw sewage can still enter the bay, however,

during heavy rains via lift stations, if the power fails, or the station's pumping capacity is exceeded. The quantitative effects of this problem should be investigated to determine if the magnitude of these problems associated with the collection system is sufficiently severe to warrant improvement. Chlorination of the lagoon's discharge also should be investigated as a possible method of further reducing clam pollution in the area.

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MAP PLATES TO ACCOMPANY REPORT

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